Progress report No.4: 29 September 1988 - 29 March 1989

Contract: DAJA45-87-C-0044

Contract Value for above period: $25,000

Contract title: Advanced Tribological Coatings for High Specific Strength Alloys

1. A presentation on the progress of this contract was made on the 18th October 1988 at the 4th SCORE meeting held at Huntsville, Alabama, USA. Prior to that meeting a review of the contract progress, was carried out by members of the SDIO Tribomaterials Technology Insertion Working Group.

2. Discussions on the contract status took place with members of the SDIO Tribomaterials Technology Insertion Working Group at the MRS Fall Meeting, held at Boston, during week beginning 28th November 1989.

3. Specimen/surface treatment status

3.1 CVD coatings of aluminium

Coater: Diffusion Alloys, UK.

Claimed to be able to deposit at temperatures below 900 °C, thereby avoiding distortion and massive grain growth.

Status: Earlier plate specimens treated and a 25 micron depth of aluminised layer was formed, of hardness 360 HV 50g. But the high temperature treatment caused softening of the substrate (from 380 HV to 280 HV 20kg). Further plate specimens have been treated and examined. Coating depths of up to 30 microns were achieved. These latter specimens have a surface hardness of up to 400 HV 50g and show reducted softening of the substrate (350 HV 20kg). Attempts are in progress to evaluate the effect of high temperatures on the diffusion of the aluminium and to increase the formation of hard titanium aluminides.

3.2 Plasma boronising

Potential Coater: Birmingham University, Degussa

Status: Coater has declined to proceed, other potenial sources such as Degussa's are being approached.

3.3 Salt bath treatments for nitriding, nitrocarburising & nitrocarburising/oxide growth

Coaters: British Metal Treatments, Poetons

Status: Metallographic sections prepared on the nitrocarburising/oxide growth process (Nitrox P) showed little surface coating or change in hardness, despite the vigorous response to the material during processing.

3.4 Gaseous Carbon/carbonnitriding

Coater: Huytons, UK

Status: Plate specimens treated and analysed. A surface hardness of 700 HV 50g has been achieved with a hardened depth of >50 microns. This is a remarkable result and further plate specimens and pin/disc specimens have been sent for processing. The process temperature was also low enough to avoid any over-ageing of the substrate. This technique looks most promising.

3.5 Plasma nitriding

Coaters: JJ Castings and Blandborough-Nemo, Asset.

Status: JJ Castings have declined to treat the titanium alloys and further activities are being discussed with Blandborough-Nemo and Asset. A 'special' TiN application by Asset achieved a depth of 3 microns on the plate substrate. Adhesion appears to excellent and some pin/disc specimens for the NCT tribometer have been sent for processing. A TiN/HfN multilayer deposition has achieved a depth pf 5 microns on the plate specimens. This coating also appears promising by its good adhesion. Pin/disc tribometer specimens have been sent for treatment.

4. Future activities

It is shortly indended to select the most promising surface treatments from this study and arrange coating of rolling contact

fatigue and pin/disc tribometer specimens to evaluate their friction, wear and fatigue properties.